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GEOLOGICAL INVESTIGATION OF THE ST. FRANCIS BASIN

by

R. T. Saucier

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Vicksburg, Mississippi

FOREWORD

Authorization for the preparation and publication of this report was contained in a letter from the District Engineer, U. S. Army Engineer District, Memphis, to the Director, U. S. Army Engineer Waterways Experiment Station (WES), dated 30 July 1963, subject "Earmarking of District Funds."

Data collection, interpretations, and preparation of the text and plates for this report and its supplements were accomplished by Dr. R. T. Saucier and Mr. A. R. Fleetwood of the Geology Branch, Soils Division, WES. Messrs. K. W. Holaway and F. L. Smith of the Geology Branch assisted in various phases of the project.

The text and figures in this loose-leaf folio pertain to the entire St. Francis Basin area and were prepared primarily during fiscal year 1964. Preparation of the plates, i.e. the quadrangles and accompanying cross sections, is being accomplished over a period of several years. Fig. 1 indicates when specific quadrangles were completed and issued as supplements to the basic report. Figs. 1 and 4 are being updated as additional data become available and new quadrangles and sections are prepared. The text and figs. 2 and 3 will not be revised until the mapping of the basin is completed.

All work has been conducted under the direct supervision of Dr. C. R. Kolb and Mr. W. B. Steinriede, Jr., Chief and Assistant Chief, respectively, of the Geology Branch, and under the general supervision of Messrs. W. J. Turnbull and A. A. Maxwell, former Chief and Acting Chief, respectively, of the Soils Division, WES.

Directors of the WES during the conduct of this project have been COL Alex G. Sutton, Jr., CE, COL John R. Oswalt, Jr., CE, and COL Levi A. Brown, CE. Technical Directors have been Messrs. J. B. Tiffany and F. R. Brown.

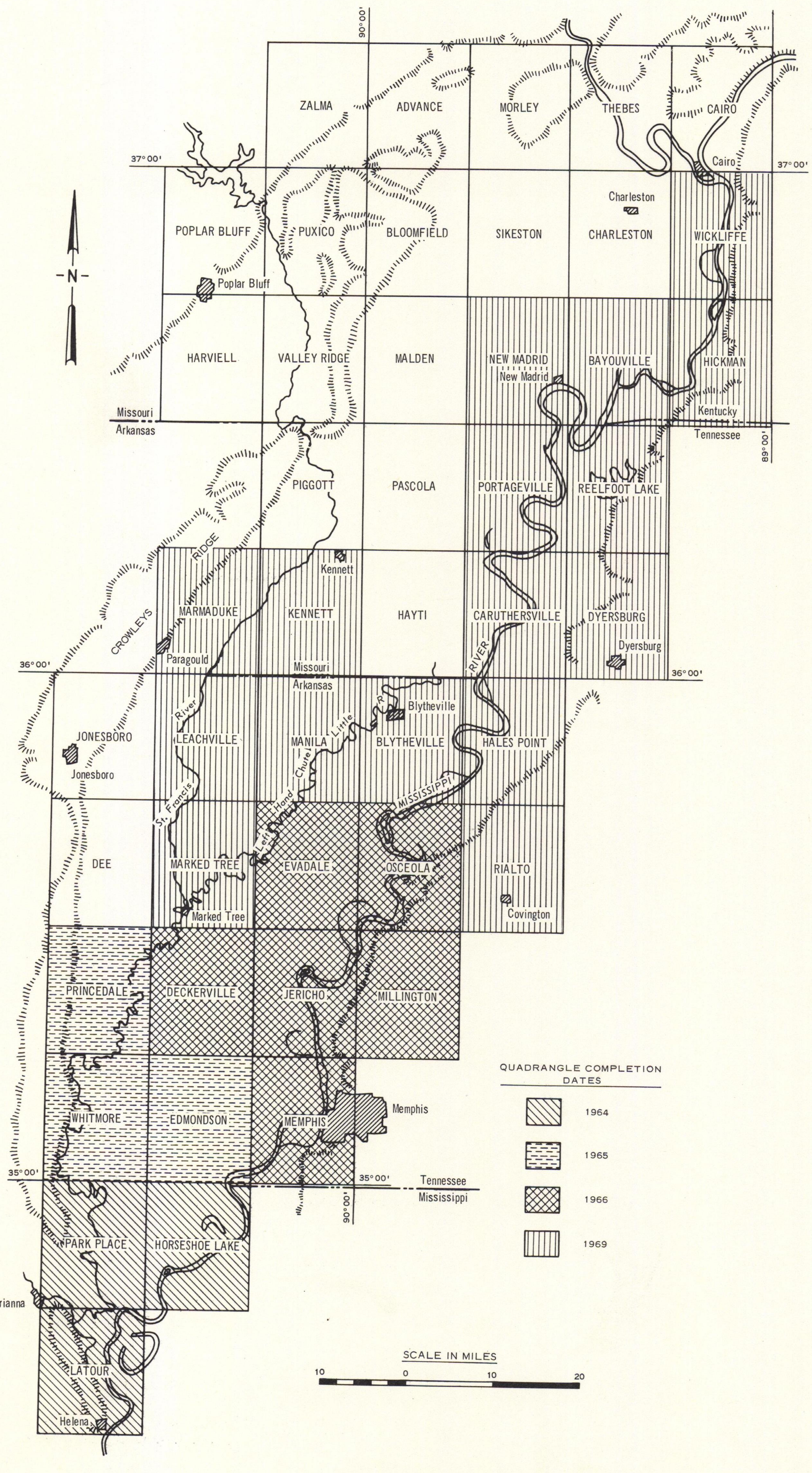

Fig. 1. Quadrangle coverage of the St. Francis Basin

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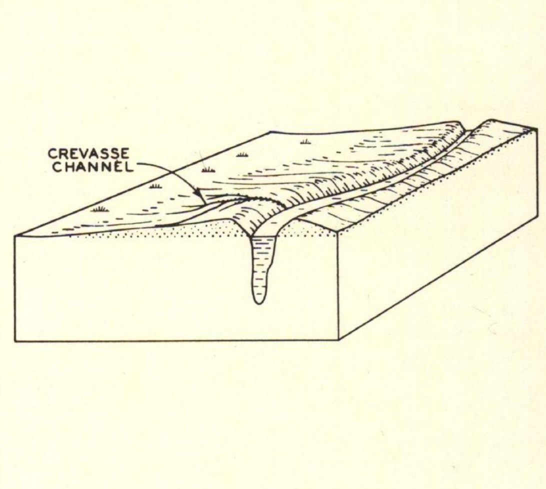
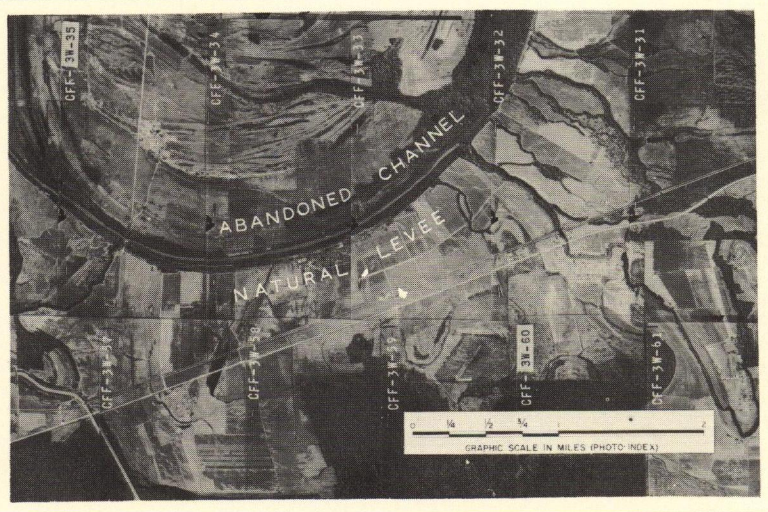
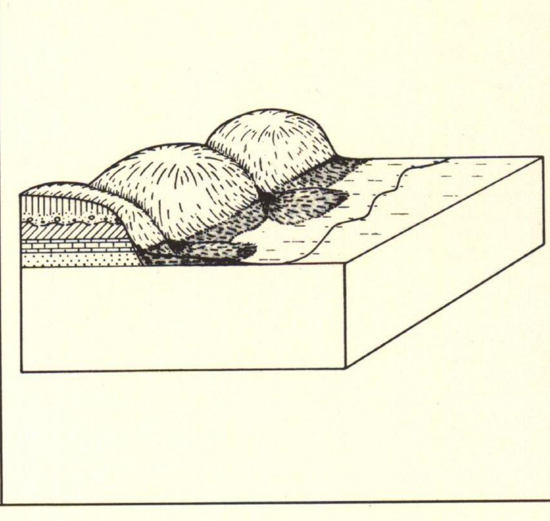
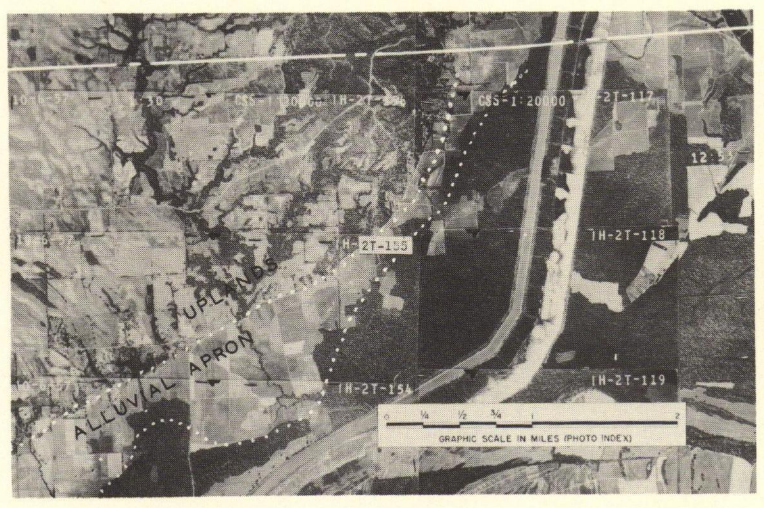
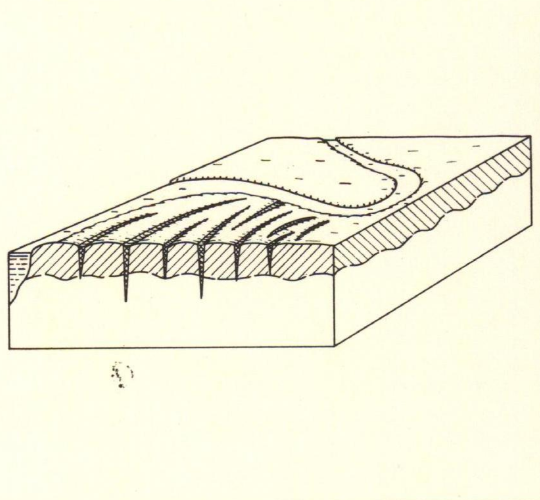
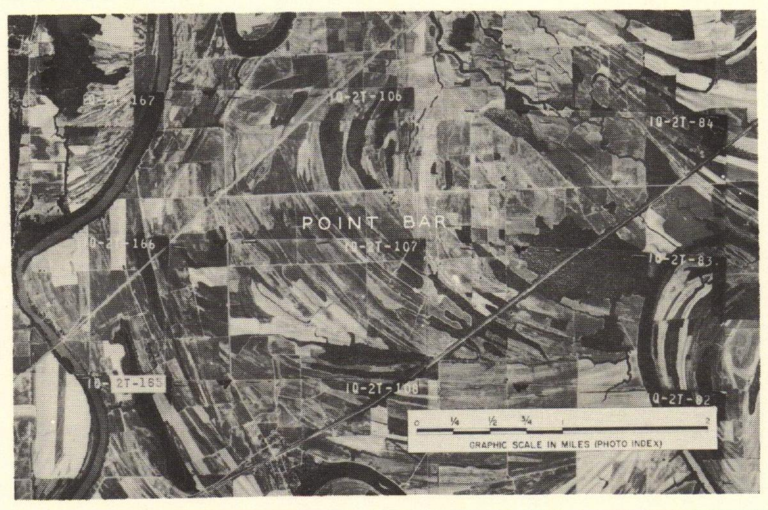
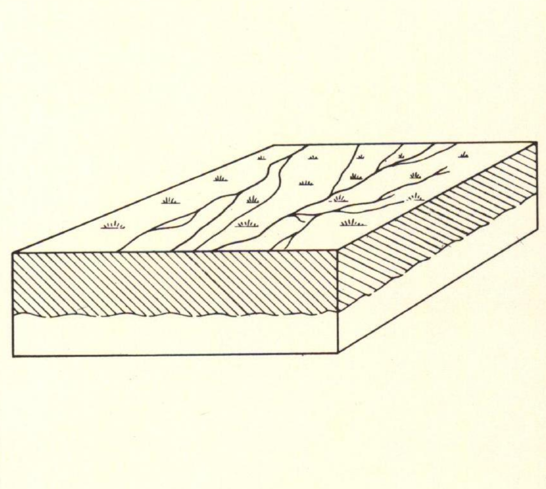
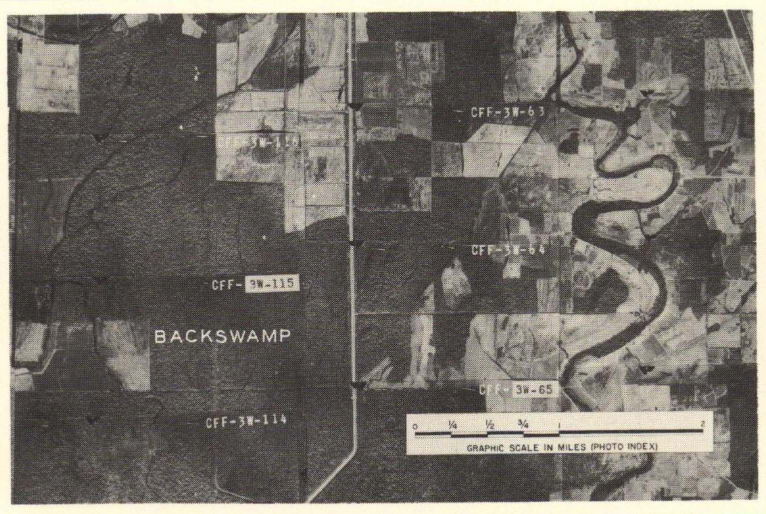
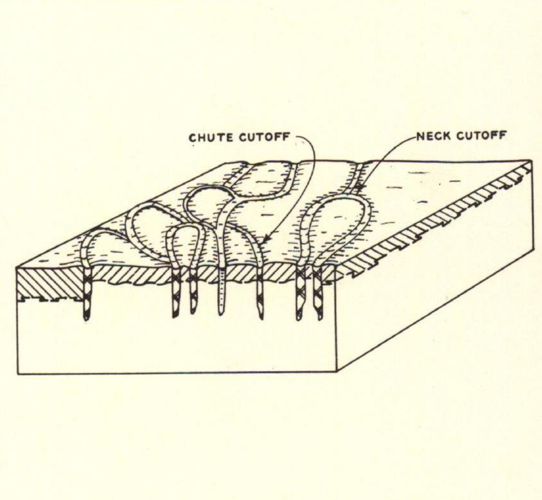
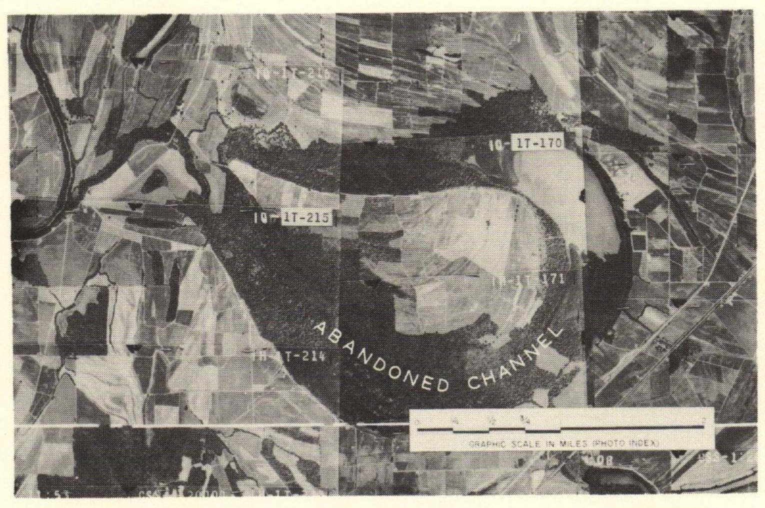
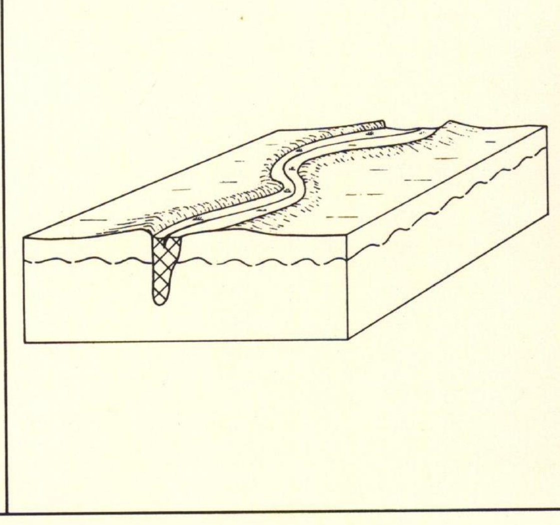
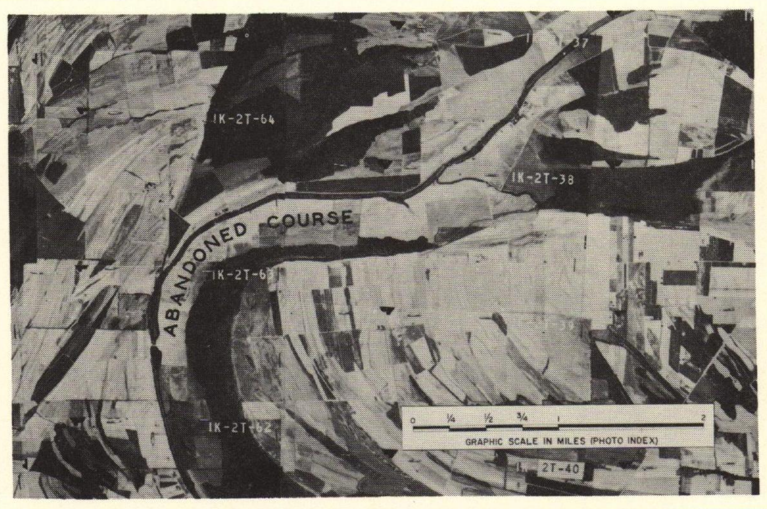
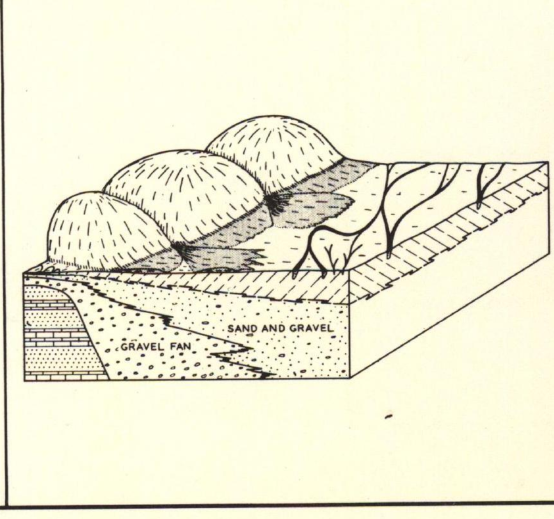
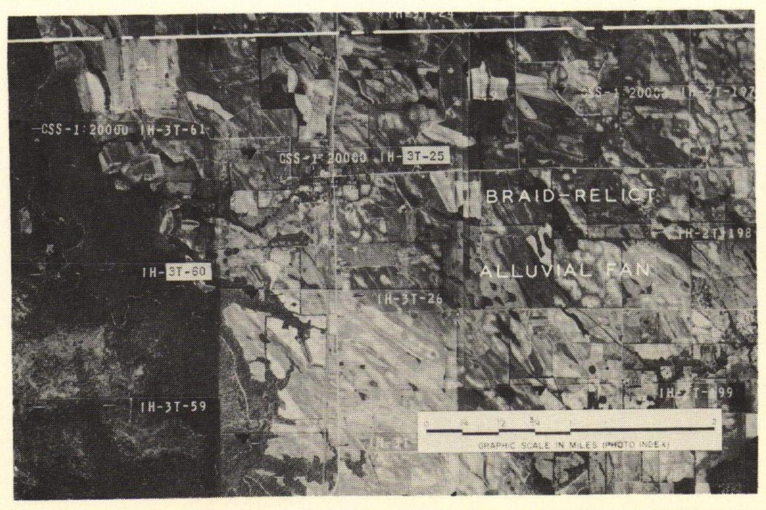
<tr><td>NATURAL LEVEE</td><td>
</td><td>
</td><td>Natural levees are low ridges which flank both sides of streams that periodically overflow their banks. Since the coarsest and greatest quantities of sediment are deposited closest to the stream channels, the natural levees are highest and thickest in these areas and gradually thin away from the channels. In general, the greater the distance from the stream, the greater the percentage of the finer grained sediments. Minute drainage channels trending at right angles to the parent stream (down the backslope of the levees) are rather common; major crevasses are indicated when these channels are large and pronounced. Abandoned crevasse channels are often filled with sediments that are distinctly coarser than the remainder of the natural levee.</td><td>The largest and most widespread natural levees in the St. Francis Basin occur along the present course and abandoned channels and courses of the Mississippi River. They attain crest heights of 10 to 15 ft above the adjacent backswamp areas, and may be as much as 2 miles in width. Natural levees are also widespread along the Lower St. Francis River and smaller rivers in the basin, but these are appreciably steeper and narrower than those along the Mississippi.
Typical natural levee deposits consist of stiff to hard, light tan to grayish-brown silts, silty clays, and clays that exhibit moderate to high degrees of oxidation. Since the natural levees are well drained, the natural water contents of the soils are low. Organic matter is seldom present except in the form of roots.</td></tr>
<tr><td>ALLUVIAL APRON</td><td></td><td>
</td><td>Alluvial aprons are combinations of alluvial and colluvial deposits which overlie the floodplain deposits along the valley walls and along the sides of upland remnants within the valley. Typically, symmetrical alluvial fans are present at the mouths of streams that drain the uplands. When these streams are rather closely spaced, the fans coalesce to form the alluvial aprons. When the streams are more widely spaced, the fans are separated, and the intervening portions of the aprons are composed mainly of sediments that have washed down from the uplands or that have moved downslope by soil creep (colluvial deposits).</td><td>In the St. Francis Basin, alluvial apron deposits occur only along the eastern flank of Crowleys Ridge. Since no streams of significant size drain the ridge, alluvial fans are poorly developed and much of the deposits is composed of colluvial materials. It is doubtful that the aprons exceed a thickness of 30 to 35 ft anywhere in the basin area.
Essentially no data are available on the composition of the alluvial apron deposits. However, since the uplands from which the deposits are derived are characterized by thick deposits of loess, it seems logical to assume that the aprons are primarily composed of clayey silts, silts, and fine sands. As far as other characteristics are concerned, they should be similar to natural levee deposits.</td></tr>
<tr><td>POINT BAR</td><td></td><td>
</td><td>Point bar deposits consist of sediments laid down on the insides of river bends as a result of meandering of the stream. Although the deposits extend to a depth equal to the deepest portion or thalweg of the parent stream, only the uppermost, fine-grained portion is included as part of the topstratum. Within the point bar topstratum, there are two types of deposits: silty and sandy, elongate bar deposits or "ridges" which are laid down during high stages on the stream, and silty and clayey deposits in arcuate depressions or "swales" which are laid down during falling river stages. Characteristically, the ridges and swales form an alternating series, the configuration of which conforms to the curvature of the migrating channel and indicates the direction and extent of meandering.</td><td>Point bar deposits are by far the predominant sediments in the eastern and southern portions of the basin. They owe their origin to meandering courses of the Mississippi River and its distributaries, and to smaller streams such as the St. Francis River. Because of successive occupations of a given area by different streams, complex patterns of ridge-and-swale topography are common.
Point bar topstratum deposits consist of tan to gray clayey silts, silts, and silty sands in the ridges, and soft, gray silty and sandy clays in the swales. Excluding the larger swales, which occasionally may be over 30 ft thick, the topstratum varies from 5 to 25 ft in thickness. Both water and organic contents are relatively high in the swale deposits, whereas they are both commonly low in the ridge deposits.</td></tr>
<tr><td>BACKSWAMP</td><td></td><td>
</td><td>Backswamp deposits consist of fine-grained sediments laid down in broad, shallow basins during periods of stream flooding. The sediment-carrying floodwater may be ponded between the natural levee ridges on separate meander belts, or between natural levee ridges and the uplands or upland remnants within the alluvial valley. Backswamp areas typically have very low relief and a distinctive, complicated drainage pattern in which the channels alternately serve as tributaries and distributaries at different times of the annual flood cycle.</td><td>Backswamp deposits are present in only a very small portion of the St. Francis Basin. They occur as isolated patches adjacent to Crowleys Ridge and between Mississippi River meander belts in the south-central part of the basin. The few boring logs available for these deposits indicate that they average about 40 ft in thickness.
Soft to firm, gray to dark-gray clays and silty clays are the typical backswamp deposits. Occasional thin lenses or lamina of silt and sand may be present. Average water contents are moderately high, but less than those of channel and swale fillings. Organic matter in the form of disseminated particles, peat layers, and stumps is commonly abundant.</td></tr>
<tr><td>ABANDONED CHANNEL</td><td>
</td><td>
</td><td>Abandoned channels, or "clay plugs" as they are commonly called, are partially or wholly filled segments of stream channels formed when the stream shortens its course. Soon after formation, they are usually characterized by open water or oxbow lakes. Subsequently, they may become essentially filled and occasionally completely obscured by various meander belt deposits. The abandoned segment may represent an entire meander loop formed by the stream cutting directly across a narrow neck of two converging arms of a loop (a neck cutoff), or it may represent a portion of a loop formed when a stream occupies a large point bar swale during flood stage and abandons the outer portion of the loop (a chute cutoff).</td><td>Abandoned channels formed by meandering streams of all sizes are numerous in various portions of the basin. Mississippi River abandoned channels or "clay plugs" are usually 5 to 10 miles or more in length (following the loop), several thousand feet in width (channel width), and up to 100 ft in depth.
The upper portions of the arms of the loops of neck cutoffs are normally filled with a short wedge of fine sand and silty sand. The soft, gray or blue-gray clays with high water contents that are so characteristic of clay plugs occur around the loop between the sand wedges. Homogeneous, soft, fat clays 90 to 100 ft thick have been encountered in Mississippi River clay plugs. Clay plugs of smaller streams contain greater quantities of silt and silty clay than do the Mississippi River clay plugs.</td></tr>
<tr><td>ABANDONED COURSE</td><td></td><td>
</td><td>Abandoned courses are lengthy segments of a river abandoned when the stream forms a new course across the floodplain. The abandoned course, varying from a few miles (but always more than one meander loop) up to hundreds of miles in length, gradually fills with sediment and is often occupied by a smaller or underfit stream. Indications are that the old course fills with a wedge of sand, thickest where the new course diverges from the old, and gradually thinning downstream. In many cases, the smaller stream meanders within the confines of the larger meander belt and destroys segments of the abandoned course. In other cases, the smaller stream delineates the extent of the abandoned course when there are no other indications of its presence.</td><td>Most of the surface expressions of Mississippi River abandoned courses have been destroyed by the meandering of smaller streams. The short, isolated segments that are recognizable are similar in size and shape to abandoned channels. Abandoned courses of smaller streams are numerous in the southern part of the basin.
Data are insufficient to describe the sediments filling abandoned Mississippi River courses, other than to state that the topstratum appears to be quite thin. Abandoned courses of smaller streams are filled with clays and silty clays that are very similar in composition and thickness to those in clay plugs. The total silt content of abandoned course deposits appears to be slightly higher, however.</td></tr>
<tr><td>BRAIDED-RELICT ALLUVIAL FAN</td><td>
</td><td>
</td><td>Braided-relict alluvial fan deposits consist of the sediments that were laid down by rapidly shifting, aggrading streams during the earlier stages of valley alluviation. The braided stream deposits were formed both by shallow, anastomosing, ancestral streams of the Ohio and Mississippi Rivers and by smaller streams emerging from the uplands adjacent to the entrenched valley. In the subsurface, the alluvial fans are characterized by a cone of coarse-grained sediments, the apex of which marks the entrance of the stream into the valley. The sediments in the uppermost portion of the fans are somewhat finer grained, and are called the topstratum.</td><td>Braided-relict alluvial fan deposits are extremely widespread in the western and northwestern portions of the St. Francis Basin. They flank both sides of the St. Francis River north of Marked Tree, Ark.
On the basis of only limited data, the deposits appear to consist of gray to tan, well-graded mixtures of clays, silts, and sands. The fine-grained topstratum (clays and silts) is probably on the order of 10 to 30 ft thick. Both water and organic contents of the sediments should be very low. The average grain size of the sediments should increase toward the northern end of the basin.</td></tr>
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Fig. 3. Nature and occurrence of Recent topstratum deposits, St. Francis Basin

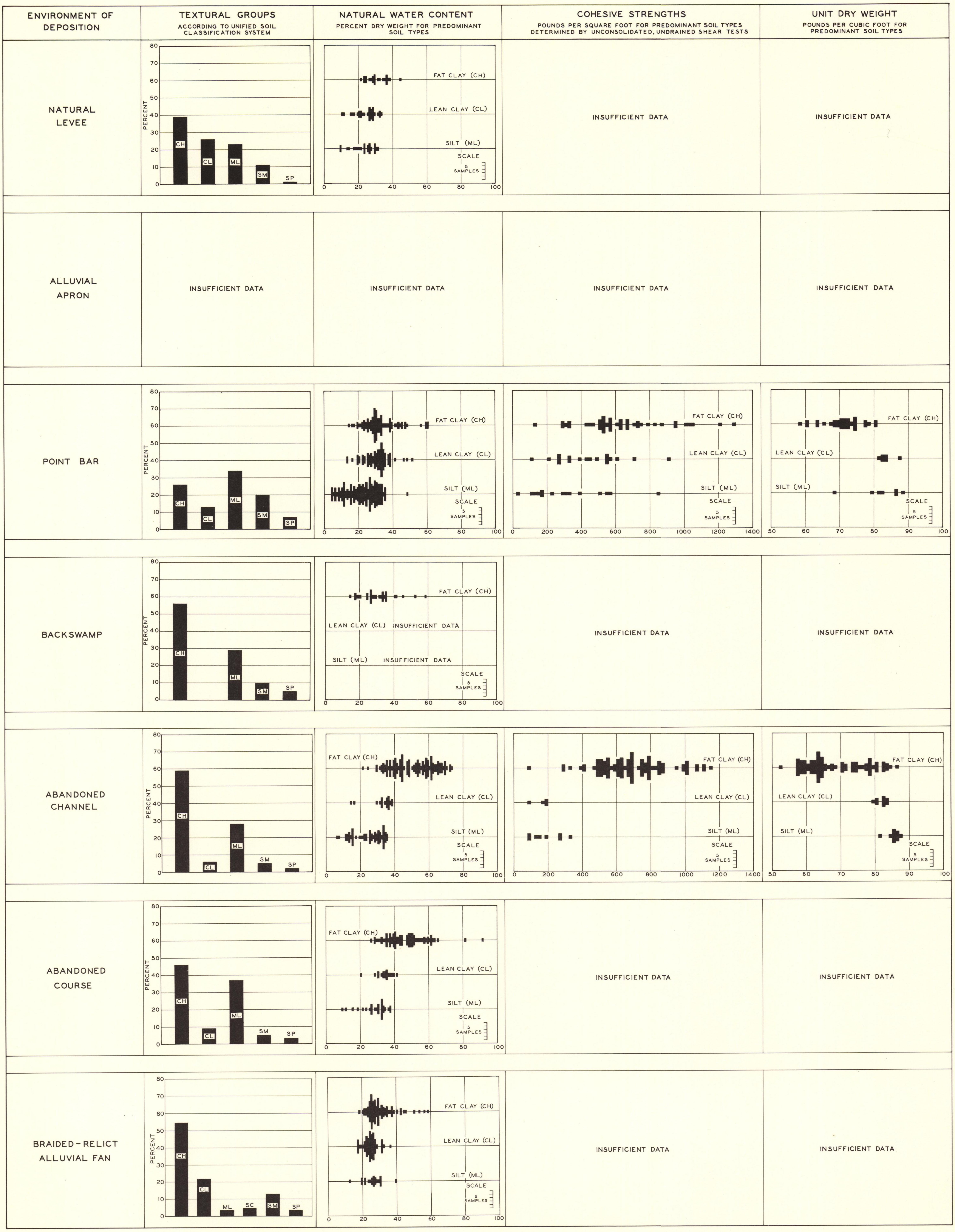
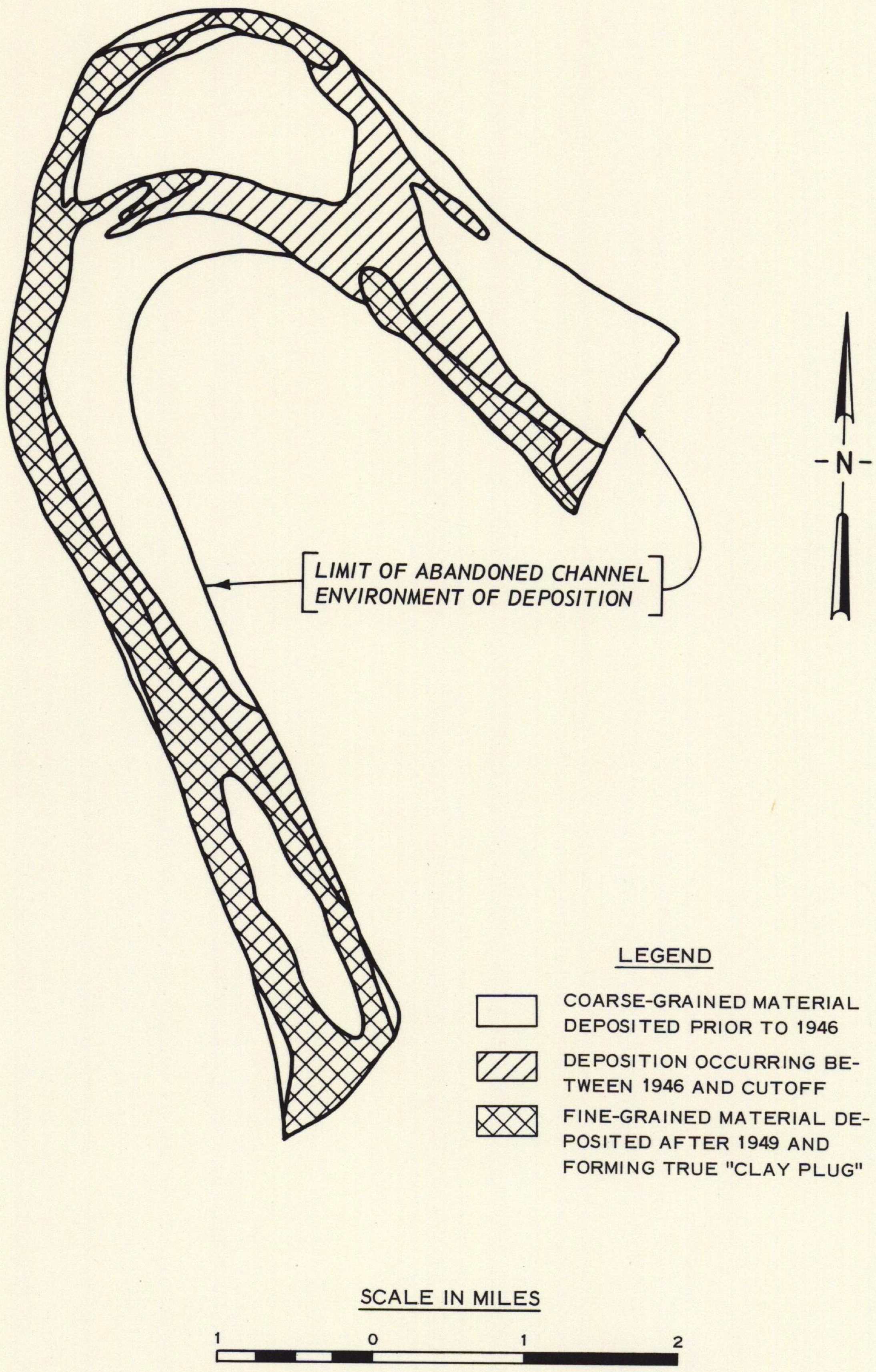


Fig. 4. Physical characteristics of Recent topstratum deposits, St. Francis Basin



The illustrative example shows the process of channel abandonment that began prior to 1946 and continued until cutoff, which occurred between 1949 and 1950. During the interval 1946-1949, coarse-grained sediments were deposited to form extensive bars in the arms and in the loop of the abandoned channel. Sediments deposited between 1949 and the time of cutoff are finer grained than those deposited prior to 1949 but coarser than sediments deposited after the time of cutoff. The coarse-grained portion of the abandoned channel environment probably does not exceed 70 ft in thickness, whereas the fine-grained true clay plug is probably no thicker than 40 ft.

In the northern portions of the Lower Mississippi Valley, such as in the St. Francis Basin, thick and narrow clay deposits may be encountered in any section of the abandoned channel.

In recently abandoned channels, standing water or swampy and densely vegetated terrain is usually the surface expression of the underlying clay plug portion of the channel fill. However, in older abandoned channels, swampy terrain and narrow arcuate bodies of standing water may not be present to mark the surface of the clay plug. In addition, masking by natural levee deposits further complicates differentiation of sediment types within the environment of the older abandoned channel.

Throughout the Lower Mississippi Valley, bars usually develop in the arms of recently abandoned channels, subsequently separating the abandoned channel from the parent river during low water stages and permitting slack-water conditions to persist in the abandoned channel.

In the northern portions of the Lower Mississippi Valley, the Mississippi River moves relatively large quantities of coarse-grained sediments. Bars forming in the upstream arm of recently abandoned channels tend to develop as sand wedges, often extending around the channel loop, whereas bars forming in the downstream arm are not as extensively developed. These bars fill much of the abandoned channel to a level generally above former bank-full stage with relatively extensive coarse-grained deposits that have depths approximating those of the former channel. Elongate and unfilled remnants are left, usually marking the flanks of the former channel. During high water stages, the river carries fine-grained sediments into the slack waters of the abandoned channel and deposits them in a thin veneer over the bars and fills remnants of the former channel to a level generally below former bank-full stage with deposits collectively known as the clay plug.

In the central and southern Lower Mississippi Valley, where the Mississippi River moves relatively small quantities of coarse-grained sediments, bars are generally not extensively developed in the arms of recently abandoned channels. During high water stages, fine-grained sediments are carried across the bars and deposited in the slack waters of the abandoned channel to form a usually continuous clay plug deposit closely approximating the configuration of the former channel.

Fig. 5. Areal extent of sediment types in typical abandoned channel

GEOLOGICAL INVESTIGATION OF THE ST. FRANCIS BASIN

The St. Francis Basin

1. As discussed in this report, the St. Francis Basin is that portion of the Eastern Lowland of the Alluvial Valley of the Lower Mississippi River which lies between Helena, Ark., to the south and roughly a line connecting Malden and New Madrid, Mo., to the north (fig. 1). The lowland is sharply bounded on the west by Crowleys Ridge and on the east by the Mississippi River, but grades imperceptively northward into the Morehouse Lowland. The maximum north-south extent is about 150 miles, while the east-west extent is only about 50 miles. Included within the St. Francis Basin are portions of Lee, St. Francis, Crittenden, Cross, Poinsett, Craighead, Mississippi, Greene, and Clay Counties, Ark., and Dunklin, Pemiscot, and New Madrid Counties, Mo. Principal drainage of the basin is by way of the St. Francis River which, for the most part, follows a course down the western side of the basin, and the Right Hand and Left Hand Chutes of Little River which flow southwestward through the center of the basin.

Purpose and Scope

2. In 1958, the Waterways Experiment Station initiated an investigation of the Yazoo Basin portion of the Lower Mississippi Alluvial Valley which had as its goals (a) reconstruction of the geologic history of the area, (b) determination of the areal distribution and physical characteristics of the various alluvial deposits, (c) analysis of subsurface conditions of various environments of deposition as an aid in determining foundation and underseepage conditions, and (d) determination of the nature of and the depth to the Tertiary deposits lying beneath the Recent alluvium. The investigation of the St. Francis Basin, another of the physiographic subareas of the Alluvial Valley, has the same goals. This report presents data in the same format (a loose-leaf folder to which supplements can be added) used for the Yazoo Basin report. It is anticipated that the complete investigation of the St. Francis Basin will require a period of several years, the basic mapping being accomplished on standard 1:62,500-scale topographic quadrangles supplemented by geologic cross sections. As the map supplements are prepared, the included tabulations of the physical properties of the soils and the basic descriptions of deposits and environments will be amended and/or revised to reflect the additional data.

Mapping Procedure

3. The areal distribution of the Recent environments of deposition in the St. Francis Basin is being determined largely from aerial photos and photo mosaics ranging in scale from 1:10,000 to 1:62,500 and in date from 1933-35 to 1957-58. Pertinent geologic publications such as ground-water investigations and state geological survey bulletins provide much of the data on the Pleistocene and Tertiary formations exposed on Crowleys Ridge and beneath the Recent alluvial deposits.

4. During the mapping activities, periodic searches are made to locate logs of as many borings and wells in the area as possible. Agencies such as the U. S. Army Engineer District, Memphis, the U. S. Geological Survey (Ground Water Branch offices), and the Arkansas State Highway Commission, as well as private well drilling firms, private foundation engineering firms, and oil companies, have furnished subsurface data for use in the study. The more detailed drilling logs, usually those of holes drilled by the Corps of Engineers, are used to construct cross sections through the various quadrangles and to contour the surface of the entrenched Tertiary formations.

Geologic Setting

5. Deposits of Tertiary age are exposed at the surface in the St. Francis Basin area only at scattered localities along Crowleys Ridge. Although they form the base of the ridge throughout its entire length, they are exposed only in those locations where the younger, overlying Pleistocene terrace deposits and the Pleistocene or Recent loess, or both, have been removed by erosion. From south to north, the exposed Teritary deposits range from those included in the Jackson Group through those of the Claiborne Group to those included in the Wilcox Group (see fig. 2). Data are insufficient to delineate the limits of outcrop of the various formations involved.

6. Throughout the entire basin area, Tertiary deposits underlie the Recent alluvium at depths varying from a few feet to as much as 200 ft. The appreciable differences in depth are a result of cyclic entrenchments of the Mississippi and Ohio Rivers and various tributaries during Pleistocene times when these streams were eroding vertically as well as horizontally in an effort to adjust their gradients to lower-than-present sea levels. The lower sea levels were brought about by the large volumes of water that were trapped in continental glaciers.

7. The last entrenchment of the Tertiary surface is evidenced by a dendritic pattern of separate trenches, the deepest and widest of which in the St. Francis Basin was the course of the Ohio River. This particular trench follows a trend roughly parallel to and about 10 to 20 miles east of Crowleys Ridge. Crowleys Ridge itself is an erosional remnant which lies on the divide between the Ohio entrenched valley on the east and the Mississippi entrenched valley on the west. The highest points on the ridge stand over 500 ft above the entrenched valley floor.

8. The Tertiary deposits comprising the entrenched valley floor in the basin area range from the Jackson Group through the Wilcox Group with deposits of the Claiborne Group occupying by far the largest area. Deposits of the Jackson Group occur as islands surrounded by and underlain by deposits of the Claiborne Group in the area south of latitude 35°20' N (fig. 1). Deposits of the Wilcox Group are present overlying Claiborne Group deposits north of latitude 36°20' N (fig. 1).

9. Pleistocene terrace deposits and loess occur only on Crowleys Ridge in the basin area. Because of the widespread occurrence and blanketing effect of the loess, outcrops in which terrace deposits are visible are not numerous. The terrace deposits, consisting largely of fluviatile sands and gravels, represent the basal, coarser portions of relict floodplains that have been uplifted and maturely dissected. According to most geologists, the loess represents eolian (windblown) deposits derived from braided stream deposits adjacent to the ridge.

10. The oldest Recent deposits filling the entrenched valley are included in the thick wedge of fluviatile substratum sands and gravels. This unit is by far the thickest and most continuous body of sediments of essentially one type that occurs in the basin or in the entire Mississippi Alluvial Valley. At occasional points above the deeper entrenchments, substratum deposits begin within a few feet of the ground surface and extend to depths as great as 200 ft. Although gravels occasionally may be present almost at the ground surface, the more typical substratum sequence is fine sands grading downward into progressively coarser sands, the first gravels appearing at depths of 30 to 50 ft and becoming more abundant and larger in size with increasing depth.

11. The sediments in the lower one-half to two-thirds of the substratum were deposited largely by ancient, shallow and swiftly-flowing, braided courses of the Ohio River carrying large volumes of coarse glacial debris. The upper one-third to one-half of the substratum consists of younger point bar sands and occasional gravels deposited by meandering courses of the Mississippi and Ohio Rivers and smaller rivers during approximately the last 5000 years.

12. The topstratum deposits in the St. Francis Basin include those sediments which were laid down during the latter part of the Recent epoch or approximately during the past 5000 to 8000 years. Although they represent deposition by meandering streams as well as by braided streams, they are considerably finer grained than the substratum deposits and were deposited in seven major environments. Each environment of deposition is described and illustrated in fig. 3.

13. The oldest portions of the topstratum are the braided-relict alluvial fan surfaces of the Ohio River that characterize the western and northwestern portions of the St. Francis Basin. These surfaces, elongated north-south, lie directly adjacent to Crowleys Ridge and represent deposition that took place over a period of at least several hundred years. To the east of these surfaces but west of the Left Hand Chute of Little River (fig. 1), similar, but topographically slightly lower braided-relict alluvial fan surfaces were constructed somewhat later by the Mississippi River. While these were being constructed, the Ohio River was flowing in a more easterly course somewhere in the vicinity of the present Mississippi River (near the east valley wall).

14. Perhaps as early as 4000 years ago, the gradients of the Mississippi and Ohio Rivers had decreased to the point where the streams changed from a braided to a meandering pattern in the basin area. The decrease of gradients was being brought about by the postglacial rise in sea level. It was shortly after this time (4000 years ago) that the Mississippi and Ohio Rivers first joined north of the basin area and flowed in a single channel through the basin. One of the earliest discernible courses of the combined system (from now on referred to simply as the Mississippi River) trends roughly along the present river course south to a point east of Marked Tree, Ark., where it then curves in a gentle arc to the southwest and south along the present course of the Lower St. Francis River past Helena, Ark. (fig. 1). Although occupation of this course lasted for only several hundred years, it was long enough for the meandering stream to cut into and destroy some of the earlier Mississippi River braided-relict alluvial fan surfaces.

15. Upon abandonment of the above-mentioned course, the Mississippi River established itself in its present meander belt past Memphis, Tenn. (fig. 1). Numerous cutoffs and the resulting formation of clay plugs have occurred within the meander belt, but there have been no major shifts in course.

16. The establishment of the river in its present meander belt did not mean the end of Mississippi River sedimentation in the Lower St. Francis River area, however. For long periods of time, the Little River system served as an outlet for floodwaters that entered the upper end of the St. Francis Basin. Its well-developed natural levees and other meander belt features attest to its role in carrying sediment-laden floodwaters of the Mississippi River. In addition to this system, a major distributary of the Mississippi River known as Fifteen Mile Bayou developed in the extreme southern end of the basin, remnants of which are discernible in the area east and south of Marianna, Ark. (fig. 1).

17. For several hundred years and up until rather recent times, the St. Francis River turned abruptly eastward or northeastward near Marianna, Ark., followed the abandoned Fifteen Mile Bayou meander belt, and discharged into the Mississippi River in the vicinity of Memphis or just south of Memphis. This constituted a reversal of flow direction in the Fifteen Mile Bayou meander belt as compared to when it was a Mississippi River distributary. It was not until perhaps as recent as 500 years ago that the St. Francis River adopted its present course south of Marianna, Ark.

Environments of Deposition

18. As mentioned previously, the Recent topstratum deposits are subdivided into seven environments of deposition (fig. 3). Each environment represents a specific method of deposition of the constituent materials. The soils in each environment exhibit certain similarities in the distribution and volume of predominant soil textures and in such physical characteristics as water content and cohesive strength.

19. The delineation of the environments of deposition, based on a careful study of aerial photographs and subsurface data, becomes a key to the types of both surface and subsurface soils in an area. To state that a delineation of the environments of deposition is an infallible guide to the detailed subsurface conditions is a misrepresentation, however. This delineation is the first and most important step in an investigation, and an improvement over subsurface mapping methods in which soil types in borings some distance apart are connected by straight lines without regard to the significant soil discontinuities that may lie between the borings. Delineation of the various environments of deposition is a necessary step in an orderly development of the subsurface geologic setting and in planning a boring program to add further detail.

Explanation of Maps and Sections

20. The plates in this folio show the distribution of alluvial deposits in the St. Francis Basin in plan and in profile. On each of the base maps (plates designated "a"), which are full-scale reproductions of the latest standard 1:62,500-scale topographic quadrangles, five of the seven environments of deposition of the topstratum are shown in color. The other two environments, the alluvial apron and the natural levee deposits, are shown as a dashed and a dotted overprint, respectively, so as not to mask the type of deposits lying beneath these two essentially surficial deposits. Heavy dashed lines, largely in the areas of point bar deposits but also in other environments, indicate elongate swales or depressions of a variety of origins in which there is likely to be more than 10 ft of soft clays. The elevations of the surface of the entrenched Tertiary deposits are shown by means of red contours. The borings used to contour the surface are shown as small red dots. No attempt has been made to map the loess or any of the Pleistocene or older deposits on Crowleys Ridge; they are designated simply as uplands.

21. Where boring information is sufficient, one or more cross sections have been prepared to accompany each map. Each plate containing cross sections bears the designation "b." Where information is sufficiently detailed, principally where closely spaced engineering borings have been made, the soil types are shown in color. Note that soil types are shown only to the depths of the detailed borings.

22. The classification of soil types used in the cross sections is based on the system used by the Lower Mississippi Valley Division prior to 1950. This was unfortunately necessary because of the large number of borings used in the study that predate 1950. For comparison with more recent borings classified by the Unified Soil Classification System (USCS), and so that these borings could be used in the study, probable equivalents of the older system and the USCS were determined and are shown in the legend. It is emphasized, however, that the two systems do not equate precisely; for example, soils classified as lean clay (CL) according to the USCS may occasionally be included with the soil types shown in blue (clay sand, sandy clay, silt, sandy silt) as well as with those shown in green (clay, blue mud, silty clay, clay silt) in the older system.

SYSTEM	SERIES	GROUP	FORMATION OR SUBDIVISION	RANGE IN THICKNESS (FEET)	GENERALIZED SECTION	LITHOLOGY
QUATERNARY	RECENT		UNDIFF.	0-150		(1) ALLUVIUM. Topstratum composed of clays and silts, overlying sand and gravel substratum. Sediments represent deposition by both braided and meandering streams. Seven environments of deposition recognized. (2) LOESS. Light tan, yellow-brown, or gray, massive silty clay and clay silt. Loess will stand in nearly vertical bluffs, is calcareous, and contains scattered fossil snail shells.
QUATERNARY	PLEISTOCENE		UNDIFF. TERRACE DEPOSITS	0-250		Fine- to coarse-grained, cross-bedded sands with scattered gravel and occasional gravel concentrations. Sands and gravels typically tan, yellow, brown, red and/or black in color. Occasional thin layers of silty or sandy clay may be present.
TERTIARY	EOCENE	JACKSON	YAZOO CLAY	0-420		Mostly homogeneous, fat clays with widely scattered thin zones of silty clay. Small quantities of lignitic material and occasional bentonitic layers may be present.
TERTIARY	EOCENE	JACKSON	MOODYS BRANCH			Fossiliferous, glauconitic, sandy clay to clayey marl with occasional indurated layers and thin silt lamina.
TERTIARY	EOCENE	CLAIBORNE	COCKFIELD			Gray to gray-brown, lignitic, silts, and fine sands. Lignite and occasionally stiff gray-brown clays occur as distinct beds. All materials highly lenticular. Silts and sands become more abundant near base of formation.
TERTIARY	EOCENE	CLAIBORNE	COOK MOUNTAIN			Calcareous, glauconitic, clay, sandy clay, and sand.
TERTIARY	EOCENE	CLAIBORNE	SPARTA SAND	0-1600		Massive beds of white to gray fine- to medium-grained sand, interbedded with thin lenticular beds of lignitic clay and sandy clay, and a few beds of gray to brown sandy clay and lignite.
TERTIARY	EOCENE	CLAIBORNE	CANE RIVER			Green and brown clay, sandy clay, marl, and sand. Sand is most abundant in the lower part of the formation. All portions of the formation are calcareous, glauconitic, and fossiliferous.
TERTIARY	EOCENE	WILCOX	UNDIFF.	100-920		Fine- to medium-grained sand and sandy clay, in part lignitic, and carbonaceous clay and lignite containing a few beds of calcareous sand or clay. Massive sand beds, common only in the basal and upper portions of the unit. Some coarse and locally graveliferous sands may be present.
TERTIARY	PALEOCENE	MIDWAY	PORTERS CREEK	200-730		Massive blue-gray to dark-gray fissile shale, clay shale, or clay with local sandy shale and sandy clay beds. Contact with overlying Wilcox often gradational.
TERTIARY	PALEOCENE	MIDWAY	CLAYTON			Gray calcareous, glauconitic, fossiliferous shale with scattered lenses of white limestone near base.
CRETACEOUS	GULFIAN		OWL CREEK			Greenish-gray mottled with yellow and brown sandy clay. Slightly glauconitic and fossiliferous.
CRETACEOUS	GULFIAN		McNAIRY SAND	>200		Beds of white, brown, and orange cross-bedded sand, and brown, laminated, carbonaceous clay.

Fig. 2. Stratigraphic column, St. Francis Basin